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TRANSACTIONS

of the

American Fisheries Society

"To promote the cause of fish culture; to gather and diffuse information bearing upon its practical success, and upon all matters relating to the fisheries; to unite and encourage all interests of fish culture and the fisheries; and to treat all questions of a scientific and economic character regarding fish."

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CONTENTS

PAGE

Fish, Forest and Game Protection in Quebec. . *Honore Mercier* 3

Importance of a Permanent Policy in Stocking Inland Waters. . . . . *John W. Titcomb* 11

Fish Waste, Past and Present. . . . . *S. P. Bartlett* 22

Production and Destruction of the Food Fishes of the Great Lakes. . . . . *S. W. Downing* 28

Conservation and Propagation of Fish in the Upper Mississippi River. . . . . *Earl Simpson* 36

Fish Cultural Activities of the Fairport Biological Station, ... *Austin F. Shira* 39

Additional Notes on Rearing the Channel Catfish. . . . . *Austin F. Shira* 45

FISH, FOREST AND GAME PROTECTION IN QUEBEC.

By Hon. Honore Mercier,
Minister of Colonization, Mines and Fisheries, Quebec, Canada.

I esteem it a great privilege to take part in the proceedings of this convention and to profit by the experiences of the many here assembled who are distinguished authorities upon the subject of conservation in general and fish and game in particular. Many of you come from states where the lack of proper conservation in the past necessitates the propagation of game as well as its protection, and all of us understand that present failure to protect what game we have must soon result in its complete disappearance. The extinction of the great auk, of the wild pigeon and the wild buffalo are constant reminders of the duty imposed upon us, of passing on to those who shall come after us, the rich supply of fur, fin and feather which has come down to us from former generations. Even in the vast Northern wild lands of the country from which I come, and in the far northwest of Canada, as well as in its far northeast, conservation is the duty of the hour, and active measures are essential to restrain the greed of gain from playing havoc with the remaining fauna of our northland.

Let me occupy a few moments of your time in telling you of some of the problems which confront me and the officers of my Department and of just a few of the natural conditions of our province; a province which has some claims upon your consideration, not only because of the very great numbers of sportsmen from these United States who go there for their fishing and hunting, but because of the vast numbers of your game birds which have their breeding grounds there.

The Province of Quebec, today, occupies just double the territory of the Quebec of five years ago. Prior to 1912, it had an area of 351,873 square miles. In that year, all the territory of the mainland of North America to the north of our then northern boundary, extending to Ungava Bay and Hudson Straits, having a superficies of 351,780 square miles, was annexed to our province, giving us a total area of 730,653 square miles, or over four hundred and fifty millions of acres. In other words, we have now a province

about one-quarter as large as the entire United States, six times the area of the British Isles, and three and a half times as large as either France or Germany.

Fully ten million acres of our territory is covered with water. Not more than 50,000 square miles of our total of 730,653 square miles is organized territory and even of this latter a large part is still covered with forest growth, and the balance, outside of the cities and towns, is but sparsely populated. Five thousand souls would probably prove to be a very exaggerated estimate of the entire population, whites, Indians and Esquimos, of the northern half of the province, or less than one inhabitant to each 70 square miles. In the interior of this vast territory various kinds of fur and feathered game roam practically undisturbed. Marvellous stories are told of the enormous quantities and size of the salmon and sea trout of Ungava Bay, of the white or polar and other bears of our northern coast, and of the trout of the Hamilton and other inland waters.

The richest and rarest furs of the black, silver, cross and white fox, of the mink, marten, fisher, skunk, otter and muskrat, come from our far north. It is estimated that the Province of Quebec furnishes more than half of the four million dollars worth of furs shipped annually from Canada to the United States, in addition to the large quantities exported via the Hudson Bay route to London and Paris by the Hudson Bay Company, Revillon Freres and others, and without taking into consideration those which are manufactured for local consumption. Until last year the province received no return whatever from its large production of furs, but the new law which I had the honor of submitting to the Legislature, gives my Department perfect control of the trade in native pelts, and imposes upon them a royalty of something like 5 per cent. of their value. Thus the people of the province are now sharing, to a small extent at least, in the large profits which the fur-dealers have been receiving out of one of our country's important natural products. This revenue will give us the means of creating a still better organization for protection and conservation.

By far the larger production, so far, of Quebec furs marketed are taken in the wild portions of the southern or more settled parts of the province, so that a large measure of protection,

based upon a proper observance of closed breeding seasons, is necessary to the maintenance of the supply. Propagation, in the shape of fur farming, has been encouraged since 1913 by my Department. In that year we published a small handbook on the subject, for the guidance of farmers who desired to add this branch of industry to their farming operations, and we also issued permits for the capture, at any time, of a limited number of fur bearers for parent stock. Previous to 1913 only a few isolated attempts at fur farming had been made in Quebec Province. At the present time, there are over fifty private ranches there for the propagation of fur bearing animals, and some of them have been extremely successful.

In the Province of Quebec, matters connected with fish and game have always been under the control of one of the Ministers of the Crown, responsible to the Legislature. At present, and for some twelve years past, it has been under the management of the Department over which I have now the honor to preside—the Department of Colonization, Mines and Fisheries. The Fish and Game Branch is one of the principal divisions of this Department.

Outside of my departmental assistants in this branch, we have a large and efficient staff of fish and game guardians. Of these no fewer than 138 are salaried by the government. There are 55 voluntary guardians without salary, (that is, sportsmen and conservationists) who because of their attachment to the cause, have asked to be sworn in as provincial wardens for the protection of fish and game, and who render efficient service without public reward of any kind. The 512 lessees of fishing and hunting rights in Quebec employ and pay 600 club guardians, making a total of 793 official fish and game wardens. All of these, including the club guardians, have commissions as fish and game wardens issued by the Department. Every one of them has the power of a constable.

Just here a word of explanation is necessary concerning the 512 lessees of fishing and hunting rights above referred to. The Province of Quebec is the only one of the Dominion which offers to sportsmen the practically exclusive privileges of fishing and hunting over large tracts of forest, lake and river territory. These privileges are leased to residents and non-residents alike. Non-

residents who are lessees of such privileges, or who are members of a club leasing the same, are entitled to non-resident fishing and hunting licenses at the lowest rates, which are only one half the prices charged to other non-residents, and in some instances even less.

The unsettled territory of the Province of Quebec, as I have already shown, is enormous, so that, notwithstanding the fact that over five hundred leases have already been granted to sportsmen, there are thousands of miles of good sporting territory still available for private preserves. Many of these leases of fishing or hunting territory, or of both fishing and hunting privileges combined, are held by private individuals; but over two hundred fish and game clubs are incorporated in the province, nearly all of which are lessees of fishing and hunting territory.

Some clubs, having a large membership and controlling fishing and hunting rights, exercise these rights over extensive tracts of country, from one hundred to two hundred square miles each in extent. Others are, of course, very much smaller. The law limits to two hundred square miles the extent of territory that may be held for hunting and shooting purposes by any one club, and five dollars a mile per annum is the minimum price that can be charged for shooting privileges.

The amount of rental charged for fishing rights depends upon both their quality and accessibility. The prices paid for them are in every case exceedingly reasonable. Leases for both shooting and fishing privileges are usually made for a term of five years, but are renewable for similar terms, though always at a comparatively slight advance in the rental, because of the increasing demand for such rights and their rapid improvement in actual value.

Many clubs and private individuals erect comfortable camps upon their leased fish and game preserves, and some of them have built really luxurious summer homes in the gorgeous woods of our north country, often overlooking a charming bit of lake or river scenery. Here they spend their summer vacation or come to enjoy their autumnal or winter hunt, often accompanied by the members of their families.

Now, let me emphasize this: the protection of fish and game was the main purpose of the leasing system, and this purpose it has

admirably served. In the incorporation of fish and game clubs, it is the principal object for which the incorporation is granted, and in all the leases of either fishing or hunting territories, the main condition of the lease is the protection of fish and game and the enforcement of the fish and game laws. It is in consideration of this protective work that the valuable privileges of practically exclusive fishing, hunting and camping are leased on liberal terms to Fish and Game Protective Clubs and to individual sportsmen.

Some of the clubs have quite a large membership, and in addition to their club-houses, their territories can now boast the existence, in various picturesque surroundings, of private camps or bungalows or other summer homes.

The Province has the benefit of the personal conservation work of its lessees of fishing and hunting rights, and of members of fish and game clubs, as well as of the 600 guardians employed by them, and in their own interest they become protectors of the forest as well as of the wild life of the woods. The importance of this forest protection is kept carefully before sportsmen in all the advertisements and other publications of the Department.

There is also quite an army of fire and forest rangers under control of the Department of Lands and Forests, and all of these are also ex-officio fish and game wardens. These men are almost constantly in the woods, and are therefore in an excellent position to detect infringements of the law. The members of the provincial Police and Detective Department are also fish and game wardens ex-officio.

This staff of wardens succeed in securing a fairly satisfactory enforcement of the fish and game laws, and in prompt detection and punishment of offenders. They have also the benefit of the aid of fish and game protective associations in Montreal and Quebec, composed of several hundred members each. These associations also employ fish and game wardens appointed by my Department, which gives an annual grant towards the payment of their salaries and expenses.

Our staff of wardens succeeded, between the 1st of January, 1916, and the 1st of July, 1917, in obtaining more than 350 convictions for violations of the law, involving fines to a very large amount. Among those recently prosecuted for infringement

of the game laws are some of the oldest and most influential corporations of Canada. One of these companies after a number of other prosecutions, which failed to procure respect for the law, has been lately condemned to a total fine of several thousand dollars, exclusive of the costs, and involving also the confiscation of 2000 pelts. These skins, of which three-quarters are beaver skins, represent a total value of about $7,000.00. We firmly believe that such results as these will produce excellent effects, proving to the average citizen that game laws are not enforced alone against the lower orders of the people, and showing the wealthy that none are rich enough or influential enough to be above the reach of the law.

I have referred to the intimate connection between forest protection and the conservation of fish and game. It may interest you to know what our province has done and is still doing for the conservation of its forests. It has a system of fire and forest rangers which includes the services of nearly a hundred forest rangers and about four hundred fire rangers and each of these is also, ex-officio, a fish and game warden. They are appointed by the Department of Lands and Forests and their names are suggested by the lumbermen who have acquired the right to operate in parts of the Crown forest. These holders of timber limits have been organized by the Department into co-operative associations for protection against forest fires and they receive every year financial aid from the Government.

It would be interesting for members of an association like yours to go through our game laws and see how severely we are now dealing with poachers. Records are kept of all infractions and we have in the Department a copy of every judgment rendered. We have the name of every one against whom an action is taken, the nature of the offense and also the place where it occurred. This allows us at a glance to pick up the record of former offenses and by sending to the prosecuting officer a copy of judgment obtained previously, to establish before the court the status of the accused.

For a third offense, there is now a fine of from one to five hundred dollars for each infraction. That is to say, if a person is caught with 100 beaver skins, he is liable to a fine of $1,000.00 up to $5,000.00.

But if we believe that it is our duty to protect the game on our territory, we believe also that it is our duty to work in conjunction with our neighbors and to help them protect their own. This is the reason why, during the last session of the Legislature, I had a special section inserted in the law which empowers me not only to seize game taken illegally on the territory of the Province of Quebec, but also game unlawfully killed or taken outside the province and brought in, and to send such game to the proper authorities of the state or province where it was illegally taken.

This part of our law has already been put into operation with two of our Canadian provinces and I am ready to work it out with the State of Maine and any other state which may be interested.

The salaries of the fire rangers are paid by the lumbermen who have acquired the right to operate in portions of the Crown forests. Our forests, capable of producing saw logs, pulp wood, etc., cover 130 millions of acres. Of these, six to seven millions are in private hands, the balance being public property, though the right to cut timber on 45 million acres has been let to lumbermen. From these leases and from stumpage dues on timber cut on these "limits," as they are called, the province derives a large revenue every year.

The value of our standing timber has been conservatively estimated at six hundred millions of dollars. The necessity for a scientific management and efficient conservation of this valuable domain inspired the Government of Sir Lomer Gouin in 1905 to take steps looking to the establishment of a skilled forestry service. Two young men, who now head that service, were sent to the Forestry School at Yale. After graduation they visited the principal European forests, and organized the Forestry Service in 1909, which was followed the next year by the opening of a School of Forestry at the University of Laval, in Quebec. The Forestry Service has charge of the forest rangers, and includes thirty-three forestry engineers. Under its system of inspection the wild lands of the province are classified as to their suitability for agriculture or for forest growth. Waste lands and those which have been stripped of trees and are unfit for agriculture, are being planted with nursery stock.

Reforestation is being encouraged in every possible way and a provincial nursery for forest trees has been established at Berthierville, capable of producing millions of infant trees. Since its establishment more than 1,500,000 infant trees have been shipped to the lumber companies, private individuals, scholastic institutions, etc. With all due precautions against forest fires and with a generous encouragement of the reforestation movement, there is reason to look forward to an increased rather than a lessened area of forest growth, so essential to the national wealth and the conservation of our water supply and fish and game.

There are several forestry reserves in our province. We have also three fish and game reserves: the Laurentian Park, 2531 square miles; Trembling Mountain Park, 14,750 acres, and Gaspe Park, 2,500 square miles. The first one is already organized and the others also will soon be organized.

I feel that I should not conclude these remarks without congratulating you upon the final adoption of the treaty, between the rulers of our respective countries, for the protection of migratory birds, in the passage of which considerable interest was manifested by the Department over which I have the honor to preside. Our laws have been for many years past in unison with the provisions of this treaty, and if they had not been so it would not have taken long to have made them so.

IMPORTANCE OF A PERMANENT POLICY IN STOCKING INLAND WATERS.

By John W. Titcomb,
State Fish Culturist of New York.

Had I been requested to talk on this subject twenty years ago I should have accepted the invitation with less hesitation than I did for this occasion. The longer and more varied one's experience in the conservation of the aquatic resources of this country, the more apparent and complex become the difficulties which present themselves when attempting to discuss the subject in a brief address before an association which is national in scope.

I shall therefore confine myself specifically to waters of the latitude with which I am more familiar, but at the same time I shall outline a plan which may be applied to all states.

Just at this crisis in our history the fishery resources of the country are receiving especial attention and many impractical recommendations have been made by well intentioned persons who are not familiar with the subject, as well as by some who, from selfish motives, want to let down the bars to conservation and to disregard the laws of nature which are the basis for regulations in regard to the methods and seasons for taking fish. A recent news item says that "By direction of the Governor of Wisconsin, the Conservation Commission of that State will seine all rivers within their jurisdiction for rough fish to combat the rising prices of foodstuffs." Another item says that "Iowa will probably be the first State to amend the laws in order to permit the free use of rough fish in the Mississippi River." College professors have come forward with recommendations to loosen up on the laws for the protection of fish during the present war. Incidentally I may say that similar appeals are being made to those in authority with reference to the taking of all kinds of game.

In commenting on this let me say that ***proper regulations for the protection of fish are as essential to the stocking of our waters as is fish culture and all efforts relevant thereto, and that if the fishery laws of the various states were fundamentally right before the war they are just as essential today as they were then.***

In a crisis like the present one, it is quite proper that we should scrutinize our fish laws with a view to ascertaining whether they are sound, and if not, steps should be taken, by legislation if necessary, which will permit the taking of fish to the fullest extent permissible *without depleting the annual supply;* but all the regulations with reference to the fisheries should be so administered that the annual crop of fish next year and in years to come will be greater than it is this year. Let us hope that we may never be obliged to draw upon our national resources to the extent of depletion, but let us properly conserve our resources now in order that we may be prepared to meet any emergencies which may arise in the future.

There are undoubtedly instances in nearly all states where food fishes, which do not readily take baited hooks, are protected at all times by laws which permit the taking of fish by angling only. In many waters the presence of carp, suckers and other rough fish is a hinderance to the natural reproduction of the species which it is desired to encourage. In such instances the commissioners or those administering the laws should have authority to remove and to permit others to remove such fishes under proper regulations. In other words, the farming of a body of water should be with a view to maximum annual production of the kind of fish crop that it is desired to produce. Fishes which are detrimental to that crop should be treated as vermin. Fortunately this sort of vermin, at the present time, is a valuable food resource if made available.

I do not imagine that you expected a dissertation on protection in connection with the restocking of waters, but you will agree with me that regulations are as essential to the attainment of results as is fish culture in all its phases.

Fish Commissioners come and go. I am sorry to say that I have seen only a few here today whom I have met at earlier conventions, which I have attended during the past twenty-seven years. Now what shall we do to overcome this condition? We have good men on the Boards of Commissioners, who are serious minded, self sacrificing and public spirited. When first appointed most of them know very little about conservation, either fish cultural or protective. The more they are connected with the work the more interested they become and the more they realize

its importance. Soon after they begin to be thoroughly interested and to learn about the needs of the various waters under their jurisdiction, out they go and a new commission is appointed.

In the early days, those who were interested in fish culture or in restocking waters, knew less about the subjects than they do today. Very few people realized the seriousness of introducing to certain waters fishes which were not only indigenous, but on the other hand were antagonistic to the native inhabitants of such waters. Consequently many more mistakes were made then than are made today. In the Northern States, especially in New England and New York State, when the trout became depleted, it was discovered that the basses, both large and small mouth, are very prolific and that the introduction of a few pairs into a depleted trout pond showed quick results. As a sequence the commissioners introduced the bass into many trout waters.

The bass increased rapidly and thrived until the few remaining trout were exterminated. When this food was exhausted, the bass, in several instances, became a stunted race because of the lack of food; in other instances they furnished indifferent fishing. Some of these waters are of too small area and of too low a temperature to expect satisfactory results with the bass, which require large range and more food than the trout which they replaced, but the bass are there and what are we going to do about it? They do not easily respond to poison as do many other species. If the pond or lake can be drawn to a small area, either by excavation at the outlet or by siphoning, it may be possible to clean them out and start over again. This plan is feasible only in comparatively few waters. For other waters we must accept the bass permanently and in order to make the waters most productive it is important to introduce some other species which will not only furnish food for the bass, but will also produce food for the people who are not expert anglers. One of the commonest fishes to be introduced has been the yellow perch. It is a very prolific and good food fish and has the advantage of being easily caught by women and children.

In many waters, such as I have described, pickerel have been introduced, not usually by the commissioners, but by individuals. Trout waters which contain pickerel, but which do not contain black bass, may be restored to their former conditions by destroy-

ing the pickerel by the use of copper sulphate. In most instances, however, this is too large an undertaking, and here again the production of a lake may be increased by the introduction of yellow perch, and if the waters are of large area the pike perch may prove a valuable acquisition. Some of the waters which I have described are fed by trout streams and, if they are quite cold, the bass or other introduced enemies of the trout may not be so serious a menace to the latter, if the protective close season is not applied. In such instances those most competent to judge should decide upon the species, which, under existing conditions, will produce the best results.

If it is decided to specialize with trout, stock with that species annually and introduce food for them if necessary. Give the commissioners power to annul the close season on black bass for that particular water, or have the open season the same as for the trout. In other words, do not protect two antagonistic species of fish in the same waters, or attempt to please the tastes of both the trout fisherman and the angler for bass by restocking the same waters with both species. Another way to encourage the trout in such a lake and at the same time reduce the number of bass, is by screening the nests of bass before the fry scatter, making it possible to thereby effect their removal to suitable rearing waters, or directly to waters in which it is desirable to specialize with the bass. It may be that some natural trout lakes contain also yellow perch. It is a very simple matter to annually patrol the shallows of the lake during the spawning season of the perch and to take up and transfer the spawn of the perch to hatcheries, or directly to waters where it is desired to encourage the perch. These suggestions with regard to the removal of bass fry or perch spawn are equally applicable to other species of fish, and it may readily be seen that by carrying out this policy, one is not only conserving the trout, but is also conserving the young or eggs of a species of fish objectionable in that particular water, but very valuable in some other body of water.

In the state which I represent, three species of trout are propagated, namely, native brook trout, the German brown trout and the rainbow, or steelhead trout of the Pacific Coast. Experience has shown that both the brown and rainbow trout are very destructive to the native trout, and yet they are a valuable

acquisition to some waters of the state which, during the summer, become too warm to meet the requirements of the native species.

In looking over the records of the past eighteen years I find that one of the more important lakes in New York has been stocked with thirteen different species of fish. Without enumerating the species, you all know that it is impossible to expect successful results with so many species, and you also know that many of these species must have been antagonistic to each other. Undoubtedly there were applications for all of the species that have been introduced. There is a tendency among anglers, who do not give a thought to the serious results which may follow, to ask for some new species which they have heard about, or which they have enjoyed catching in some waters to which they were native. It has been the habit of fish commissioners to cater to the many tastes of the individuals. It is impossible, however, to suit every individual in one particular water. The trout fisherman must go to the natural trout waters and the bass fisherman must go to the waters which are naturally productive of bass, in order to obtain good fishing.

Lake Sunapee, in New Hampshire, is well known to anglers from almost every state in the Union. This lake also has received many species of fish. I wrote one of the former commissioners of New Hampshire in regard to this lake. His reply was "Fishing all gone to hell; not a salmon this spring. The Chinooks were good for a time, but do not reproduce and have all been caught out. They have dumped lots of fish in the lake, but they seem to do us no good." I might go on giving specific illustrations of this kind indefinitely, but it is unnecessary. You all know the conditions of your own waters and whether you are propagating or protecting in the same waters species which are antagonistic to each other.

It becomes apparent that in order to obtain the best results, a permanent policy must be established with regard to each stream, pond or lake which is to receive attention. In other words, the commissioners of the different states should have a survey made of all the waters under their jurisdiction which are to receive any attention in the way of restocking. The results of the survey

should be published in such a way that the successors of those who establish the policy may have something to guide them in their efforts with reference to the same waters.

In New York State a beginning has been made along these lines by investigation of the streams of Oneida County. This county has an area of 1100 square miles and is drained by four river systems. The fish producing power of these waters is unusually large. During recent years several fish and game protective associations have assumed almost entire charge of the planting of these streams with trout and in most instances it has been the custom for these associations to apply for brook, brown and rainbow trout for each public stream, notwithstanding the fact that it has been conclusively proved that brown and rainbow trout are very destructive to the native brook trout.

The working plan resulting from this investigation has proven most satisfactory. It has been found desirable to take the entire river system into consideration; not merely individual systems, for brown trout planted in one stream in the system will in time work into the other systems, unless prevented by dams or other obstructions. This change made as the result of these working plans will tend to eliminate much waste of the state hatchery products and to develop the streams of the country to their highest efficiency as fish producers. It is hoped that similar work may be done in other counties to the end that a permanent policy may be made as a guide, not only to the state authorities who have to do with the stocking of such waters, but also that the United States Bureau of Fisheries, in response to applications for fish to stock the waters of New York, may act in unison with the State authorities with reference to the treatment of these waters.

In Vermont a step in the same direction has been taken by using the State Highway Map on which the various lakes and ponds have been brought out in strong colors and numbered. A key to the map accompanies it, and opposite each number information is given as to the name of the pond, its present inhabitants, water area, whether the pond has been reservoired or not and the future policy as to the kind of fish to be introduced. If the state and federal authorities of the future adhere to this policy, a great waste of good material will be avoided.

The information as to whether a pond is reservoired or not is given for the guidance of prospective purchasers of shore property for summer homes. In some instances the reservoiring of lakes is harmless. As to how the fishing will be affected depends upon the extent of the abnormal conditions created by reservoiring the waters and then drawing them at seasons of the year other than the natural ones for a large outflow. On general principles, the lakes and ponds which are most unlikely to be reservoired and drawn—in other words, the waters which are most likely to remain natural—are the ones in which the future fishing can be relied upon to be as good or better than it is now. It is a fact well recognized in other states that the reservoiring of lakes for water power purposes is detrimental to the fishing. For illustration, Rangeley Lake in Maine has been twice raised until now it is eighteen feet higher than the natural level. As a result, the trout fishing in the most famous of Maine lakes has been gradually falling off ever since the water level was raised.

The question of increasing the food fishes to meet the crisis under present war conditions has led to recommendations indicating that many people do not realize that fish caught by angling are food fishes, even though they are also catalogued as game fishes. It must be borne in mind, however, that many of our waters are better suited to the cultivation of so-called game fishes, like the trouts and basses, than they are for the species of fish commonly described as commercial fishes.

The selection of a proper species of fish when attempting to stock any body of water is of utmost importance in order to obtain permanent results. It is not necessary to have special application blanks for the different species. The form which is to be filled out by the applicant should give sufficient information to guide the commissioners in the selection of the species of fish to be assigned. The preference of the applicant should be stated, but unless it is a species which will produce the most satisfactory results and be in conformity with a permanent policy, an explanation should be sent to the applicant as to the kind of fish assigned and the reason for making the assignment.

Next, if not equal in importance, to a proper species of fish for stocking a given body of water, is the manner of fish planting.

Ordinarily it is left to the applicant to plant the fish. He is usually furnished with printed instructions how to plant fish; sometimes he reads these instructions, but very frequently he does not do so. It is necessary therefore to have a campaign of education as to the importance of properly tempering the water when transferring the fish from the cans to the waters which are to be their permanent homes, as well as other important features for the attainment of successful results. It is almost impracticable for any commissioner to undertake to supervise the planting of fish, except in waters where large quantities of commercial fishes are being introduced. For the game fishes it is expected that the local anglers will be sufficiently interested to receive and plant the fish, but nothing but constant hammering will educate these people to persevere in their enthusiasm at the time of receiving fish until they have actually got them into the waters in proper condition. When it becomes known that an applicant has not properly followed the instructions as to planting fish, any further applications from him should be refused.

I have been discussing a policy with reference to ordinary streams, ponds or lakes. The policy with regard to waters of large area may be varied somewhat from the permanent policy which should be established with the smaller lakes. The species to be selected for the larger lakes is dependent to some extent upon whether reliance is to be placed on artificial propagation to maintain the supply, or whether, after once introduced, a protective close season and natural reproduction are to be depended upon.

In any attempt to establish a permanent policy with reference to the selection of species for stocking a water system, it is apparent that the farm fish pond and the privately stocked and posted stream must be under the supervision of the commission and that the proper selection of species to be encouraged in these privately controlled waters must be made with reference to its effect upon the inhabitants of the public waters to which they are tributary.

In this connection I ask your indulgence while I wander from the subject to say that we should encourage the fish pond on the farm by furnishing fish to stock such private waters at cost, just as the states supply trees at cost for reforestation.

The owners of artificial ponds which do not receive a supply of fish from public waters, but which are stocked at the owner's expense, should have perfect freedom to take the fishes from these ponds at all seasons, but they should be under the direction of the commissioners as to the species propagated when such ponds empty into public waters.

In the encouragement of fish ponds on farms, progress in this direction will never be what it ought to be until the public are educated to recognize private ownership of fishes which are artificially propagated or privately controlled in ponds privately owned. Under present conditions public sentiment is such that people will steal fish who will not steal umbrellas.

The owner of the private fish pond must also be encouraged and educated as to how to construct his pond and as to the results he may expect from the utilization of his waters. He should also be instructed as to the species of fish that will probably thrive best in the proposed pond. I recently had an inquiry from a man who wrote as follows: "I have a small lake of fresh, running water. I would like to raise in it flounders, carp and pike; let me know whether these fish will stay in such waters." It is needless to comment before a body of fish culturists as to the ignorance of the public on this subject. Another man recently wrote asking for young fish for a lake 75 by 175 feet, and expressed a preference for pickerel, bass, trout and white perch. You will all agree with me that one cannot off-hand make recommendations for the kind of fish suitable for this man's little pond, but to give you an idea of the action taken in this matter there follows a copy of the letter which was written in reply.

"Receipt is acknowledged of your letter of May 7th, making request for a number of species of fish for a small lake 75 by 175 feet. From the size of the pond it is assumed that it is a lake over which you will wish to retain your personal control, and for that reason will not want to receive fish from the state which would necessitate opening the waters to the public. If such is not the case, it is suggested that you use the enclosed application blank to describe more particularly the water and give other information called for. If you desire to purchase fish, the commission will give you a list of dealers, and in that case if you will fill out the

portion of the application blank which describes the lake more particularly, this office will be in a position to advise you as to which species to select. The introduction of pickerel, bass and trout to so small a body of water means that the pickerel and bass would quickly destroy all of the trout. They would then prey upon each other until it would be a survival of the fittest. For a lake of that area neither pickerel nor bass is suitable. If the waters are sufficiently cool, with a constant flow of cold water through the lake, trout are recommended."

SUMMARY.

In summarizing, allow me to condense what I have said and to add to it by making some specific recommendations.

1. List the waters under your jurisdiction and establish a permanent policy as to the species with which you will specialize in each.

2. Prohibit the introduction of any species of fish foreign to the waters, unless approved by the commission, and also the introduction of any species contrary to the established policy; this to include connecting privately stocked and controlled waters.

3. Co-operate with the United States Bureau of Fisheries in the adherence to a permanent policy as to the selection of species for restocking waters in which both authorities are interested.

4. Give the commissioners power to exterminate and market rough fish at any time and by any means, either directly or by the issuance of licenses. By rough fish is meant those kinds which are antagonistic to the maintenance of a successful, permanent policy already decided upon. It is immaterial for statistical results whether fish are taken by nets or by hook and line. How fish are taken should be regulated according to local conditions and effects upon property values. In this connection the value of recreation, as an asset in its effect upon property values, must not be under rated.

5. The selection of species for planting in any water system should be determined with reference to a permanent policy, in the hope that our successors will continue the policy which we have established.

6. A campaign of education as to the importance of care in planting should be waged in order to save wastage.

7. Educate the public also to appreciate private property rights in fish when privately propagated entirely under the control of the owner.

8. In the present crisis, conservation of our resources is of greater importance than at any previous time in our history, and proper regulations for the protection of fishes is as important as fish propagation.

9. The farming of our waters should be with a view to maximum annual production of the kind of fish crop that, after careful investigation, it is decided to specialize in.

10. The retention in office of men conversant with the propagation and protection of fishes is essential to insure the best results.

11. Finally, build for the future generations regardless of present political conditions. Leave a monument for yourselves by setting an example for your successors, whether of the same political faith or not. Set a pace for them and turn over to them such complete records of your work that there can be no excuse for not following the permanent policy which you have established.

FISH WASTE, PAST AND PRESENT.

By Dr. S. P. Bartlett,
U. S. Bureau of Fisheries, Quincy, Ill.

In presenting this paper I wish to say that I have no idea that I am stating anything that is particularly new, or much that is educational. I presume that this and kindred subjects will be fully covered by abler men than myself, but it is possible that it may introduce into the discussion some features peculiar to certain localities and therefore not touched upon by others. I intend to deal particularly with conditions as I have known them on the Mississippi and Illinois rivers.

Away back there more years than I care to contemplate now, when then there were no protective laws, the supply of buffalo, the principal market fish, was so large that people seemed to take it for granted that it was inexhaustible. Bass, crappie, sunfish, perch, etc., bore little part in the commercial lists, and as I have said, the buffalo was the food fish for the markets. With an improvidence hard to understand, the farmers and the fishermen took advantage of the season when these fish most needed protection, the spawning season, when the fish, rolling in shallow water, became easy victims. With any and every kind of device they took them by the thousands, and, unfit for food at that season, they were not only destroying them but their natural increase as well.

Taken in such immense quantities, they had to be marketed at once, if saved at all. They were shipped by boat, generally to St. Louis, from points all along the Illinois and Mississippi rivers, in barrels, sugar hogsheads, crockery crates, boxes, anything procurable, dressed if time permitted, or rough when it did not. So many were offered, at times, for shipment that I have seen a large proportion refused by the boats, and such as were left spoiled of course, as no ice was used. The boats being en route for only ten to twelve hours at most, the fish were packed and shipped, if possible, the day they were caught. Most of the fish thus shipped were on consignment, and investigation showed

that more than one half of the shipments were dumped into the river, owing to a glutted market and the soft condition of the fish. I have seen numbers of account sales showing a balance due the consignee, the sales failing to pay freight.

Such wholesale depredations on the supply could only result in its depletion, if not its extinction, and the output decreased so rapidly that the number of fish dealers dwindled down to only a few here and there, in the towns along the rivers, who shipped dressed fish to inland towns and sold locally. The buffalo were nearly out of the market and the game fishes, bass, crappie, sunfish, perch, etc., became favorites and were sought for in the markets. These conditions were finally brought to the attention of the state legislatures and the result was the enactment of protective laws, but the buffalo never regained its former status as the principal commercial fish. Carp were introduced into the public waters and by their rapid growth and increase have supplanted the buffalo and taken first place in the market as a coarse fish.

So much for the fish waste of former years, before the importance of fish protection and conservation was understood, in those lavish days when all of nature's gifts were under-valued because of their bountiful supply. What can be said in excuse of the waste in supply, the indifference shown in failing to utilize every pound of food and every means available to increase the quantity in these days of enlightenment, when one is urged daily to do all in his power to conserve and increase all the resources of the nation? Not only could fish be a part of the economy of every farm, but the methods of the market fishermen are as wasteful as in former years, though in different ways.

Let me illustrate: Seining in Illinois waters is lawful from September first to April fifteenth of the following year. The earlier seining is usually in warm weather. Many of the seines are from 1000 to 1500 yards in length and are handled, as a rule, by gasoline winches. The fish taken are put in live boxes and either transferred to others or anchored to await time for use. Many of the fish die from injuries in the seine or live boxes and it is not unusual to find the surface of the water in the live box in the morning covered with dead fish. These are all thrown back into the river, not only a loss, but a menace to the health of the com-

munity as well. The live fishes in the boxes are taken out as wanted and dressed, the offal thrown into the river, usually taken into the current of the river and allowed to float away. This refers only to the coarse fish, as bass can not be taken lawfully with seines or nets at any time in the year and sunfish and crappie, strange to say, are slow at markets and the waste in dressing them is light, as they are scaled and the heads left on. Fish confined in live boxes suffer greatly, as they are usually crowded, the water generally warm and the slow current changes the water correspondingly slowly, so that a considerable percentage always die and, as stated before, are dumped into the river again.

As soon as seining is lawful in the state the big seines are put to work on the Illinois river in the great stretches of water such as Peoria Lake, Havana Lake, Meredosia Bay, and in similar places along the Mississippi river. In all my knowledge of the fishing industry, I have noticed that it has been the custom of the smaller fishermen to take their fish daily to a fish boat or market and sell them in the rough. Here ensues more waste as only such fish as are lively enough to keep in their boxes are paid for, or, if the fish are needed for immediate dressing and shipment, only those red in the gills are used and the rest go overboard, as a rule. Frequently the fish taken from nets which have not been raised for a day or two in warm weather, are thrown out at the time or taken to the shipper with the others and all that are not fresh are thrown into the river there.

Some years ago I was coming up the Illinois river on the steamer "Illinois," then working jointly with the U. S. Fish Commission, and after passing the dam, a Government lock at Kampsville, we ran into a stream of dead fish floating on the surface of the water—thousands of them. This continued for fifty miles, frequently great fields of them covering almost the entire surface of the channel of the river, then a thin stream of them, but always dead fish in sight. When investigated as to the cause, it proved to have been a large catch all along the river with warm weather and a glutted market, and fish dying in live boxes were thrown into the river—a criminal waste of good food through bad methods and lack of care. This was not a frequent occurrence in such numbers, of course, but is not unusual to some degree, as a trip along the Illinois in a boat or launch will prove.

Another product of the fish is lost and wasted which could be utilized to great profit, as I have reason to believe. I refer to the universal practice of throwing into the river all of the waste resulting from dressing and preparing fish for market. In dressing buffalo, carp, catfish and the like, the scales, skin and head with collar bones and entrails are thrown into a tub and later dumped into the river, and this waste matter constitutes an important percentage of the fish.

One instance that I recall will serve to illustrate the amount of such matter that is thrown into the river, its value lost and the waters polluted at the same time. Some years ago in early spring, when the ice started to move in the Illinois River, fish seeking security on the lee side of an island moved into Moscow Bay, situated below Havana. The bay was at a good stage and fed by springs in part, thus affording earlier clear water than the river generally. A lot of farmers living near discovered the run of fish and joined seines with the fishermen, for farmers then, as now, carried seines as a part of their equipment. They surrounded the bunch of fish and the haul netted 300,000 pounds. Seine brails were brought ashore, the seine well staked and fish were taken out with dip nets and hauled away as they were wanted. The weather was cold and it took a couple of weeks to complete the job. Then the fish, or most of them, were cleaned and shipped. All the offal from the catch followed the usual route, and the greater part of all such refuse after dressing fish is still being dumped into the rivers. All the waste of the fish that is thus thrown away could be utilized, the fat be rendered into oil and the other parts converted into fish meal and used as food for hogs or fowls. Not only the refuse can be so utilized, but the dead fish should also be rendered.

In the use of a seine, large or small, scarcely a haul is made that does not bring ashore immense numbers of hickory shad. They are considered worthless and are simply shaken out of the seines and left on the shores to decay, a menace to health and comfort, if nothing more, but if they could be saved they would give a fair return in oil and fish meal. This I have seen demonstrated years ago, but the experiment failed to pay because at that time the Illinois laws prevented the use of the seine. Now

what are the possibilities of conserving this wasted product for the benefit of the people as well as for those engaged in fishing for market. I take it that in order to carry out the implied instructions of the federal authorities, the greatest attention should be given to conserving everything that can save waste. Along the Illinois River alone there is thrown overboard enough valuable product to aggregate in the course of a year a large amount of money, reckoned as hundreds of thousands of dollars. How to save it so as to make the salvage best worth while seems to be the question.

I have been interesting myself in the problem and, after seing some of the experiments made by Dr. Chas. W. Greene, of the University of Missouri, at work at Meredosia and points on the river in the interest of the United States Bureau of Fisheries, I am convinced of the possibilities of securing practical results and I am indebted to Dr. Greene for many valuable suggestions.

Dr. Greene was making some experiments on the eggs of carp and other fish for a possible use for caviar. This material, from the carp and buffalo, particularly early in spring, can be had in great quantities, at points along the Illinois river, for the taking. The shovel-bill or spoon-bill, which had a large run this season, would furnish a large supply also, if their eggs were taken early enough, and would seem to offer a valuable factor in this industry. More than a hundred thousand pounds of shovel-bills were caught, dressed and shipped to St. Louis markets as sliced or boneless catfish, selling F. O. B. at Meredosia at fourteen to seventeen cents a pound. Enough waste was thrown away from these fish to have paid a fair profit, if it could have been saved.

Dr. Greene took five and one-half pounds of fat from the belly of a spoon-bill, a strip along the belly, as I understood it, as the fat if cooked with the fish is objectionable. From this fat he rendered two and two-fifth pints of fine oil, which from appearance and subsequent analysis, after being clarified, proved to be equal to some of the fats used for cooking. Dr. Greene also advanced what seemed to me practical ideas as to saving all waste in dressing and also the dead fish now thrown away; the dead fish to be utilized by extracting the oil and converting the residue into fertilizer, while the waste procured in cleaning fish, after removing

the oil, may be made into fish meal for feeding. The material of all the waste saved would be at least valuable as a fertilizer and perhaps some of it might be profitably used as food for hogs or fowls. This would bring good prices with grain so high.

How this could be utilized with economy sufficient to make it profitable, is as yet an unsolved problem. I have been obtaining literature on the subject from the various manufacturers of the apparatus necessary to the work, but so far find the cost of the outfit too great for practical working, as, if only one outfit was possible, the cost and difficulty of transportation and of time would have to be considered. The points at which the largest quantities of fish are dressed, Peoria, Havana, Beardstown and Meredosia, could maintain small outfits perhaps, but none of them a large one.

It is possible that the next session of the Legislature will enact laws prohibiting the throwing of masses of refuse of this kind into the rivers, polluting the waters, which would necessitate some other method of disposing of it, and perhaps this may result in saving it.

PRODUCTION AND DESTRUCTION OF THE FOOD FISHES OF THE GREAT LAKES.

By S. W. DOWNING,
U. S. Bureau of Fisheries, Put-in-Bay, Ohio.

In discussing this question we will confine our remarks to the conditions on lake Erie, and more particularly to that portion of it bordered by the States of Ohio and Michigan. In the beginning, it would seem that nature so adjusted the production and destruction of fishes and all other animal life, that the natural increase and losses just about balanced. In course of time all the waters, both of the ocean and the fresh inland bodies, became well stocked with fish and the numbers were steadily maintained so long as the natural conditions were not disturbed, but as soon as mankind discovered the value of fish for food and financial advantages, an unnatural loss was created. At first this loss was but slight, but as more fish were consumed and the demand and price increased, more effective means were employed. Today the demand and the price have so advanced that every means that man can devise are used in taking fishes. The consequent result has been that natural production could not keep pace with natural destruction when combined with the artificial destruction carried on by the commercial fishermen in order to meet the constantly growing demand for fish as food. In order to restore the balance to normal or natural conditions, this artificial destruction must be overcome, and to do this many means have been suggested and tried and production by artificial or protected propagation has been adopted. We will endeavor in this article to show the number of young fish so produced at the U. S. Fisheries Station at Put-in Bay, Ohio, together with that of the Ohio State hatchery, which is but a stone's throw away from us, by the following table covering the output of the past sixteen years.

AT THE U. S. STATION.

	WHITEFISH	PIKE-PERCH	HERRING	LAKE TROUT	PERCH
1902	125,472,000	55,000,000	20,200,000	.....	.....
1903	200,500,000	160,087,000	.....	.....	.....
1904	71,125,000	145,000,000	1,500,000	884,000	.....
1905	53,250,000	139,275,000	23,300,000	913,000	.....
1906	120,300,000	152,800,000	3,400,000	900,000	.....
1907	140,000,000	135,400,000	50,000,000	897,000	.....
1908	87,500,000	229,000,000	35,010,000	.....	.....
1909	190,000,000	80,000,000	3,200,000	.....	.....
1910	139,000,000	80,250,000	.....	.....	10,000,000
1911	75,020,000	89,375,000	70,300,000	.....	.....
1912	191,100,000	116,280,000	.....	.....	.....
1913	197,300,000	46,500,000	.....	.....	3,000,000
1914	163,200,000	69,600,000	.....	861,000	.....
1915	209,000,000	56,400,000	3,400,000	350,000	.....
1916	175,500,000	68,300,000	.....	.....	.....
1917	203,500,000	115,500,000	.....	990,000	.....
Total	2,341,767,000	1,740,767,000	210,310,000	6,607,000	13,000,000

This shows a total production of all kinds of fish at this station during this period to have been 4,310,551,000, or an average of nearly 270,000,000 for each of the sixteen years considered.

During the same period the Ohio State hatchery produced and liberated in the same waters, 642,000,000 whitefish, 1,194,-000,000 herring; 558,000,000 pike-perch; 10,000,000 perch and 6,000,000 saugers, a total of 2,410,000,000.

The fish produced by fish cultural work in this one vicinity in sixteen years has been as follows: Whitefish, 2,983,767,000; herring, 1,404,310,000; pike-perch, 2,298,767,000; perch, 23,000,-000; lake trout, 6,707,000, and saugers, 6,000,000; making a grand total of 6,722,551,000 fry produced by the two stations. This number added to the natural production resulting from the eggs deposited by the fish themselves upon the natural breeding grounds, gives us the production of that part of Lake Erie upon which the fish cultural work under consideration was conducted, and there can also be added to the lake at large the product of the Pennsylvania State hatchery at Erie, and that of the hatchery conducted by the Canadian Government.

Of course we are not claiming that the 270 millions of fry produced each year at the U. S. station at Put-in Bay, or the millions produced at the other stations means a production of that number of adult fish each year. Neither can we give even an approximate estimate of the number that reach maturity in the Great Lakes, but judging by the percentage known to have reached the age of reproduction after having been liberated at the fingerling stage, we think that it is safe to estimate that at least ten per cent. of all the fry liberated would reach maturity if not destroyed by other than natural causes. If so, then there were produced each year from this station alone 27 millions of fish and averaging them at two pounds each, we have a production of 2,700 tons a year. As the kinds of fish propagated are of the best varieties and sell for the highest prices in the market—perhaps an average price of 12½ cents a pound to the consumer would be a fair estimate—this would give us a production of $675,000 worth of fish each year. To digress a little from the subject, I will say that the total cost of this production, including salaries, pay for eggs, temporary labor, both in the field and at the station, the upkeep of the station, together with the maintenance and the entire cost of operating the Steamer Shearwater, which is used in collecting the eggs and distributing the fry, has averaged less than fifteen thousand dollars a year. This leaves a clear profit of $660,000.00 a year. So much for the production, now we will endeavor to consider the destruction and some of the conditions which cause it.

The natural destruction begins with the loss of the fertilized eggs deposited by the parent fish on the spawning grounds, which are eaten by the ground-feeding fishes, such as suckers, mullets, redhorse, and in fact by all the aquatic life that feeds on the lake bottom; also those eggs which become covered with mud and silt and are smothered; the young fish eaten by the minnows during the early fry stage, and the fingerlings eaten by the larger fish. This loss can not be estimated, neither can it be controlled to any extent, but the greatest source of destruction, and one that can be controlled, is that which is carried on by mankind. This destruction should be divided into two classes, the economical and legitimate, and the unnecessary, wanton and criminal. By

the economical and legitimate we refer to the taking of those fish which have reached the age and size of maturity, the taking of which is or should be legalized by the state or federal laws, for as soon as fish of any species have attained their full maturity and have been given a chance to reproduce, the sooner they are removed from the waters in which they grew, the better it is for their own species. If left in these waters they consume the food that were better left for the consumption and growth of the younger fish. Therefore we have no quarrel with the fishermen who remove them, the dealers who by purchasing them encourage the taking, nor the laws of the different states which make such fishing legal. However, we can not too strongly condemn the wanton destruction of undersized and immature fish, such as are annually being taken from the waters of Lake Erie and placed upon the market. Although the present prices that are being paid for all kinds of fish are very tempting and make it profitable, just for the present, for the fishermen to bring them in just as small as they will be accepted, it is suicidal to his own business provided he expects to remain in the business two or more years longer, as will be shown later.

Most of the states bordering upon Lake Erie have laws regulating the size of most of the fish that may be legally taken, and as a rule the size limit is large enough, provided they are rigidly enforced, or conscientiously lived up to. But again, some of the most valuable species are not mentioned in the statutes of some of the states. For instance, of the four states bordering upon Lake Erie, Ohio has more coast line than all the others combined, and a far greater area of breeding grounds than all the others. This is especially true of two of the best and highest priced fish that are being produced, i. e. the whitefish and the pike-perch, and also they are the two species that are being propagated to the greatest extent, as a glance at the table giving the number of fry produced at the hatcheries will show.

We think, for this reason, the State of Ohio should have the most judicious and stringent laws possible for the protection of the young of these fish, yet one of these—one of the very best and highest priced food fishes taken in Ohio waters—has no protection whatever by the laws of the state which regulate the

size of the fish that may be legally taken, and in consequence tons of undersized pike-perch that would require from three to eight to weigh a pound can be seen on the market during both the spring and the fall fishing seasons. However, we would not be understood as censuring the fishermen, or even the dealers, too strongly for this great destruction of immature fish, as the very great demand and the high prices offered makes the temptation to offer anything that will be accepted on the market very strong. It is but natural to get all we can today without due thought for the future, and so long as there is no legal restraint placed upon them, we must expect the fishermen and dealers to follow the present custom.

As to whitefish, one of the best and highest priced of the fresh water fishes, it is fully protected as regards the size limit in the states of Ohio, New York and Michigan, the legal weight being two pounds in New York and Michigan and one and three-fourths pounds in Ohio. An experiment conducted by the writer showed whitefish of this weight were fully matured. Two hundred males and two hundred females were measured and weighed, with the following result: Males, 34 weighed 1¾ pounds, 78 weighed 1½ pounds; 74 weighed 2 pounds; 8 weighed 1¼ pounds, and 2 weighed 1 pound each. Females, 120 weighed 2 pounds, 56 weighed 2¼ pounds; 10 weighed 1¾ pounds; 8 weighed 2½ pounds and 6 weighed 1½ pounds each. This gives us an average of one and seven-tenths pounds each for the males and a trifle over two pounds each for the females. These fish were selected from about six thousand that were being held in pens; as the smallest fish were taken for the test, and all the males were found to be ripe, yielding milt freely, and the females were all heavy with eggs, so it was evident that they were all mature fish. If the size limits of these several states are not violated, the whitefish, in so far as size is concerned, is amply protected. Unfortunately this is not the case as the following incident will show: A fish dealer of Sandusky, Ohio, one day accosted the writer, saying that he had some fish at his fish house and would be glad to be advised as to what kinds they were, and upon examination they were found to be herring and young whitefish. Fifteen of these young whitefish were placed upon the scales and altogether weighed just

five pounds, an average of three fish to the pound. Although the herring, being fully matured, were in a fair state of preservation and still fit for food, the whitefish were so soft and mushy that they were entirely worthless and the dealer afterward informed me that they were all sorted out and sent to the reduction plant for fertilizer, and that just one-third of this fifty barrel shipment were these undersized whitefish. This is but one instance and one shipment.

The adult whitefish as they are taken in Lake Erie run about two and a half pounds to the fish, so that it requires eight hundred of them to weigh a ton. If the undersized fish are taken, those weighing a half or a third of a pound each, then it takes from four to six thousand of them to weigh a ton, for every ton of them placed upon the market there is an absolute destruction of from 3,000 to 5,200 fish in actual count. Moreover in many cases, as in the one cited above, they reach the market in a worthless condition and the makings of from five to six tons of the very best food fish have been totally destroyed without profit to any one. Nor is this all the destruction resulting from the taking of these undersized fish. It is but fair to assume that one half of them were females and as they were all taken while immature they have had no chance to reproduce. The destruction of eggs corresponds to the destruction of fish, and as the average number of eggs to the fish can be placed at twenty-five thousand, then for every ton of fish there has been destroyed from forty to sixty-five million of eggs.

In the case of the pike-perch we have still a greater destruction both in numbers of fish and eggs for the reason that the fish are placed upon the market smaller in size, requiring a greater number to the ton, and the average number of eggs to the fish is about four times as great, so that even though the fish be taken of the same size, the destruction of pike-perch eggs reaches the enormous number of from 160 to 260 millions for every ton of these immature fish placed upon the market.

Then there is the financial loss. If we place the price at ten cents a pound, the fisherman himself is losing from $320 to $520 dollars in weight alone for every such ton placed upon the market, and considering the difference in price between the small and the

full sized fish, his loss is still greater. The loss to the dealer is correspondingly large, as is also the food loss to the public. Although we, the Ohio hatchery people and ourselves, have produced during the last sixteen years enough fish to equal six times the number of minutes that have elapsed since the beginning of the Christian era, we can not hope to keep pace with the natural, the legal and economic, together with this wanton and criminal destruction. Now this being the case at a time when it behooves every one to conserve to the fullest extent every article of food, when every department of the government and all state officials are urging economy in the use of all kinds of foodstuffs and that every effort be put forth for the production of the same, surely some action should be taken by those in authority to prevent the continuance of this great waste of one of the most wholesome foods that nature has given us. As a preventative we believe the most efficient means would be the enactment of a universal law by all the states bordering upon Lake Erie and by Canada as well, such a law should fix a size limit on all fish of whatever species are taken for market and make this limit large enough so that every fish whould have reached maturity and had a chance to reproduce at least once before it would be legal to remove it from the water. But whether this or some other means is adopted, something should be done and that speedily or many of our best fishes will soon become so nearly extinct that it will no longer be profitable to follow fishing as an industry.

ADDITIONAL NOTES.

Undersized Herring.—Many of the herring caught on the Canada side this spring ran very small, as did also some that were caught on the American side. I was informed by one of the Canadian Fishery officials that, as late as July 30th, he saw herring that had been caught on the Canada side and shipped to the United States that would run from four to ten fish to the pound and some of them would weigh no more than an ounce each.

Length of Whitefish.—The average length of 200 male whitefish measured at Monroe, Mich., was 16¾ inches and of the females a fraction over 17 inches, and these were the smallest of a lot of six thousand.

Comparative Waste.—During the fall of 1911, in the district where the fish cultural work of the Ohio stations are conducted, there were taken 945,010 pounds of whitefish averaging about 2½ pounds each, or a total in numbers of 378,004 fish. Had the same number of pounds been taken of the undersized fish running three fish to the pound, it would have required 2,835,030 fish, which would mean a destruction of 2,457,026 fish, and if one half of these were females, as we have a right to suppose they would be, then there would have been a destruction of 6,087,575,000 eggs.

CONSERVATION AND PROPAGATION OF FISH IN THE UPPER MISSISSIPPI RIVER.

By EARL SIMPSON,
Winona, Minn.

In treating with this subject I wish to confine myself to that part of the Mississippi River extending from the vicinity of Prairie du Chien, Wisconsin, to St. Paul, Minnesota. As is well known, this territory of the river abounds in numerous small sloughs and lakes adjacent to the river, all of which are subject to overflow in seasons of high water. As we usually have periods of high water during the spawning season of the fish that are habitat to the upper river, it results in the fish going to these numerous lakes, sloughs and pockets adjacent thereto, and later on, as the water recedes, they are left there in what we term "dead pockets," and unless rescued and placed in the river they die.

The fish abounding in the upper waters of the river, other than the commercial fish, are the small-mouthed black bass, pike, sunfish, catfish, crappy and pickerel.

In 1914 the first systematic work in rescuing these fish was commenced along the river, and in the beginning necessarily was limited in extent, but the results derived even from the small amount of work done clearly showed to those interested the great possibilities that might be attained along this line. At first the work was limited to the members of the Winona County Fishermen's Association. Then the Latsch Board, who control numerous bottom lands adjacent to Winona, became interested in the work and, finally, the United States Bureau of Fisheries Station at Homer, Minnesota, took up the work. During the season of 1916 practically all the dead sloughs and pockets in the territory extending from Trempealeau, Wis., to Minneiska, Minn., about thirty miles in extent, were seined and the fish placed in the main river, with the exception that a small per cent. were retained by the Government and used in stocking the numerous lakes and rivers in Minnesota and Wisconsin. It is estimated that at least five million game fish were saved through this work, and the greatly improved condition of the fishing in the vicinity

of Winona during the past season has clearly shown the wisdom of this policy. We feel that if the other cities, located in the territory in which this work could well be undertaken, would interest themselves in this matter, it would be but a short time until the upper waters of the Mississippi would become the finest fishing territory imaginable.

Restocking the river in this manner is different from the ordinary methods adopted in restocking streams and lakes, in that the extent of transportation of the small fish is practically nothing. The fish are taken in the seine directly from these pockets to the river, or placed in pails and tubs and transported quickly, so that there is practically no loss from this source. If these fish are once placed in the deeper water, even though we do have higher water level in the season, they do not go back to the sloughs and pockets, but care for themselves in the deeper water. The expense involved is very small when we take into consideration the results obtained. A crew usually consists of three men, a small launch, a seine and a few tubs and pails. Two men operate the seine and the other transports the fish. It is estimated that such a crew will rescue one hundred thousand fish a day.

Even though the dead sloughs and pockets do not entirely dry up and the fish live through the summer season, these small bodies of water will freeze to the bottom in the winter following and the fish will be destroyed in this manner.

While considering this matter, I feel it my duty to call the attention of this body to the lack of a fishway in the Keokuk Dam, located at Keokuk, Iowa, on the Mississippi. There can be no question that several species of the fish that inhabit the upper river migrate south during the fall and early winter, and once they go over the Keokuk Dam it is practically impossible for them to get back up the river the following spring. It has been said that the river below the dam at Keokuk is just alive with fish, during the spring, trying to get back to the upper waters of the river. This condition prevails especially with reference to the skipjack, which although not a food fish, is very useful in the upper river as food for the pike. Up to the time of the construction of the Keokuk dam it was a common saying along the river, that wherever you saw the skipjacks working you could

feel certain that the pike were lying below the ends of the dams and reefs where these fish were working and were feeding on the minnows that were stung by the skipjacks.

During the past three years there has not been a skipjack seen in the upper river and, as a result the pike have had a hard time to find sufficient food. They are now caught, whenever it is possible to catch them, along the shallow flats or bars, where they evidently are searching for food.

I have been told that the Keokuk dam is one of three dams in the United States which have been constructed under government supervision without requiring the construction of a fishway, the other dams being located in the western states. It would seem that this society should adopt a resolution or memorial to Congress requesting the construction of a proper and suitable fishway in the Keokuk dam, so as to permit the fish of the Mississippi to obtain free access to the upper and lower sections of the river.

FISH CULTURAL ACTIVITIES OF THE FAIRPORT BIOLOGICAL STATION.

By AUSTIN F. SHIRA,
Director of the Station.

While the work of the United States Fisheries Biological Station, Fairport, Iowa, is known primarily for its service in connection with the propagation and investigation of fresh-water mussels, its field of activities is quite broad and includes in its scope various fishery problems of a specific or general nature. This multiform functioning is clearly stated by Dr. R. E. Coker in his recent article descriptive of the Fairport Station.* For present purposes the work may be conveniently divided as follows: 1. Mussel Propagation; 2. Fish Propagation; 3. Associated Activities. The first and third will not be dwelt on at length here, but in passing it will be stated that under the former are included both the practical and experimental phases of artificial mussel propagation.

My object at this time is to present to you some of the less familiar activities of the station grouped under the second heading. This heading may be further sub-divided into (a) Intensive pond culture; (b) Artificial hatching in jars; (c) Studies of natural food, and (d) Experiments in artificial feeding of river fishes.

(a) *Intensive Pond Culture.*—The pond cultural experiments have been designed to augment our knowledge of the conditions most conducive to increasing the productivity of small ponds on farms or elsewhere. In order to accomplish such an end, it is of course quite necessary that the problem be attacked from the small pond owner's point of view to some extent. The possessors of small ponds desire to have their ponds well stocked with fish, primarily for the meat furnished the table and also for the sport afforded in catching them. The farmer is a busy man; but he is beginning to realize more and more that recreation as well as a greater variety of diet makes for increased energy and efficiency. The fish pond helps to meet these requirements, by furnishing sport on the one hand and acceptable food on the other.

*Robert E. Coker: The Fairport Fisheries Biological Station—Its Equipment, Organization and Functions. Bureau of Fisheries Document 829.

However, the time has not yet come when the pond owner will give any considerable attention or care to the pond, and any results that may reward his slight efforts are largely due to naturally favorable conditions. It behooves us then to attack from this view-point in order that we may supply the information for meeting the present demand, while at the same time we are gathering data for an educational campaign for the better care and utilization of small ponds for increased production.

Accordingly, experiments are being carried on to furnish information as to the best combination or combinations of fishes for best results, and the greatest number of fishes a pond of given size can support for an optimum growth, with and without artificial feeding. In one of our ponds (0.224 acres in area) originally stocked in 1914 with adult large-mouth black bass, crappie and bluegills, the bluegills have practically taken possession of the pond. The experiment was permitted to run along for a period of three years without an increase or decrease in the stock, save by natural causes, but an inventory was made each fall. Originally stocked with 30 large-mouth black bass, 45 crappie and 40 bluegills, this pond yielded a total of 103 bass, 12 crappie and 3,945 bluegills when drained in the fall of 1916, after having run for three seasons. This year the number of bluegills was reduced to 1,500 and the experiment carried on as before except that since July 1 five pounds of fish are taken from the pond weekly. The object is to determine whether or not such a pond when once well stocked will be self sustaining when subjected to regular fishing.

Experiments in the rearing of large-mouth bass together with bluegills have been carried on for comparison with the results obtained with bass alone. While no final and conclusive statement can be made, the indications are that the best results can be obtained with bass alone. This year we are carrying on additional experiments with bass and the orange-spotted sunfish together. In another pond we are carrying over yearling bass, bluegills and buffalofish. The logical combination would seem to be such fish as the bass, crappie and bluegills, with some form that feeds largely on the bottom, such as the bullhead, buffalo or golden shiner. Within a few years we hope to be in position to give some very definite information relative to the kind and number of fish best suited to a pond of a given type and area.

Bass, crappie, sunfish and bullheads are the fish ordinarily used in stocking small ponds, but in view of the demand for fishes that reach a larger size attention has been given to two other fishes as possibilities for this purpose; namely, the buffalofish of the genus *Ictiobus* and the channel catfish, *Ictalurus punctatus*. The European carp should also come in for additional attention in this regard.

Experiments with the buffalofish were started in the spring of 1915, with young fish artificially hatched in Downing jars. One hundred and eighty thousand fry were placed in a small earth pond and later transferred to a pond of about one acre in area. In the fall this pond yielded about 50,000 fingerlings, varying in length from one to six and one-half inches. While this is not a phenomenal growth it was very encouraging when consideration was given to the fact that the pond was new and devoid of vegetation. Thirteen fish that had been placed in a small pond containing abundant vegetation had reached an average length greater than six inches. The rearing of these fish has been continued and this year at an age of two years some of the fish retained had reached a length of seven and one-half inches. Additional fish were hatched last year and this year and further experiments are being carried on. This season two ponds have been devoted to yearling buffalo, about 1,000 per acre in one and about 3,000 per acre in the other. These fish are being fed partially on artificial food and good growth is being made. In two other ponds of equal size, fry were placed, 2,500 in one and 6,500 in the other. These fish are subsisting wholly on natural food and though considerable loss has been sustained, presumably caused by parasitic trematodes, the surviving fish had reached an average length of about two inches by July 12, at an age of about two months.

What we consider one of the greatest achievements is the fact that we have succeeded in inducing the buffalofish to spawn in one of the ponds. This was tried last year, but without results. The same brood stock, augmented by additional fish taken from the river this spring, was placed in an earth pond of about an acre in area. In order to simulate natural conditions to some extent, the pond was only partially filled with water when the fish were introduced and the water level was gradually raised at

the approach of the spawning season. The fish were first seen "splashing" May 11 and later on May 17, 18 and 19. The first young were seen May 26. The present indications are that the pond is over stocked, judging by the size of the fingerlings (1½ in.), as compared with the fingerlings (2 in.) in the two ponds mentioned above.

The success obtained last year in hatching and rearing young channel catfish, *I. punctatus*, in a pond at the station was described in a paper published in the Transactions of this Society for March, 1917.*

This season two small earth ponds are being devoted to some of the young reared last year, in order to obtain additional data on the growth. In one pond were placed 108 of the yearling fish with natural food only and in the other 464 fish to be fed in part on artificial food. The growth has been quite substantial and some of the fish have now reached a length of about 6 inches.

An additional hatch of young catfish was obtained in the same pond again this year.

From a stock of red-eared sunfish, *Eupomotis gibbosus*, placed in an earth pond last season, a brood of young was obtained. It may develop that this species will be quite suitable for raising with large-mouth black bass, as it is more of a bottom feeder than perhaps any other sunfish and spawns quite late, the young thus being available as food for the young bass. Young sunfish of the species *L. euryorus*, the habits of which were but little known, were also hatched in one of the ponds. The comparatively rapid growth and uniform size of the young lead one to believe that this may be a very suitable species for small ponds.

(b). *Artificial Hatching in Jars.*—In connection with the pond cultural work, experimental hatching of various river fish has been carried on to some considerable extent. As stated above, the work was first undertaken in 1915 when a hatch of 1,723,625 buffalofish was obtained. The work in the two succeeding years resulted in a hatch of approximately ten millions in 1916, and seven millions in 1917. The eggs were obtained primarily at New Boston, Ill., and as the fish from which they were taken were caught by the commercial fishermen for the market,

*Notes on the Rearing, Growth, and Food of the Channel Catfish, *Ictalurus punctatus*. Tran. Am. Fish. Society, for March, 1917. Vol. 45, No. 2.

the hatch represents a clear gain as the eggs would otherwise have been lost. The total cost of hatching and planting the fish the past season was slightly more than seven cents per thousand, including over-head expenses and the salaries of permanent employees actually engaged. It may be safely said, then, that the work is now on a practical and well established basis.

In view of the increased demand for additional cheap food fishes to supplement the meat supply of the country and aid in reducing the high cost of living, experimental hatching of the European Carp, *Cyprinus carpio*, in jars was undertaken this spring. Approximately 112,000 fry were hatched and liberated in the Mississippi River. Several thousand reserved for additional experiments, were placed in one of the ponds and a very marked growth has been made.

Some work was also done last year on the Missouri Sucker, *Cycleptus elongatus*, and 83,000 fry hatched in jars were planted in the Mississippi River. This is a very good food fish and commands a price almost equal to that of the buffalofish.

(c). *Studies of Natural Food.*—No work in pond-fish culture would be complete without a thorough knowledge of the natural food taken by the fish under varying conditions. This information is being obtained by intensive food studies carried on by both regular and temporary employees. Weekly collections of young fish are made from each of the ponds throughout the summer and fall for food examinations and the kind and quantity of food taken is compared with the available supply in the pond. Interesting and valuable data, indeed, are being accumulated. For instance, we have found that the very young buffalofish subsist largely upon rotifers which are taken in large numbers, later turning to Chironomus and other insect larvae and Entomostraca. The stomach examinations reveal the fact that all the young fish feed generally and with but little discrimination on the prevailing food of the ponds, as the proportion of the various items constituting their diet are comparable to the proportionate abundance of their occurrence in the ponds. These studies also serve as an index of the food required for optimum growth. A few examinations made last year indicate that it is desirable to continue making the collections to some extent throughout the winter so that more complete data will be at hand.

(d). *Experiments in Artificial Feeding of River Fishes.*—In order to supplement the work carried on in the ponds, artificial feeding experiments are in progress this year with fish held in troughs and tanks. In order to have clear water at all times the supply for these troughs is taken from one of the earth ponds, the water of which scarcely becomes roily even during the periods of the greatest turbidity of the Mississippi.

The fish which are being used in these feeding experiments are: fingerling, yearling and two year old buffalo-fish, fingerling and yearling channel catfish and fingerlings of the European Carp. The food consists of meal, dried and ground mussel meats, beef liver, cheese and ground table scraps. The amount of food fed the fish daily is weighed and notes of the weekly increase in weight and size are recorded.

Another phase of our work is brought out in the co-operative plan instituted this spring with the Crystal Lake Club, of Burlington, Iowa. This Club owns a lake of about 1,200 acres in the Illinois lowlands opposite Burlington and is interested in increasing the productivity of the water by propagation. Accordingly we are working with them, have diked and screened off small areas of the lake as breeding grounds and have stocked them with bass, crappie and sunfish. Evidence is already at hand indicating that a good hatch has been obtained.

This lake has been formed in the levee district and is wholly cut off from the river, except that water may enter through a 12-inch pipe at a 7 ft. stage of the river. This lake is quite typical of other conditions along the Mississippi and Illinois Rivers and the results that may be obtained by our efforts should be applicable to other places. While this co-operative work is concerned with game fishes the same scheme should be applicable to other food fishes as the buffalo, catfishes and carp.

ADDITIONAL NOTES ON REARING THE CHANNEL CATFISH, ICTALURUS PUNCTATUS.

By Austin F. Shira,
Director, U. S. Biological Station, Fairport, Iowa.

Last year a paper was prepared for presentation before this Society giving in considerable detail the results obtained in rearing the channel catfish in one of the ponds at the Fairport Biological Station. As these results constituted the first detailed record of the breeding of this fish in ponds, you will be interested in a brief account of the supplemental work done this year.

It was very unfortunate that the conditions last year necessitated the drawing of the pond to determine whether or not the catfish had spawned. In order to avoid this, most of the kegs to be used as nests this year were provided with an opening in the side about 7 x 5 inches, with a closely fitting hinged cover, so that when placed in a horizontal position in the pond, the interior could be examined by simply raising this cover. All kegs except a few buried in the bank were securely fastened to posts so that little disturbance resulted when examination was made. Twenty kegs in all were placed in the pond, fifteen of which were provided with side openings and covers. Three without openings were placed in a horizontal position in the pond bank with the mouth outward.

Several of the kegs were placed with the top within a foot of the water surface. As the water in the pond became clearer with the advance of the season, the interior of the kegs so placed could be observed without great difficulty from the pond bank when the covers were raised. On examining the deeper kegs, however, it was necessary to use a water-glass.

The brood stock numbering 40 individuals was placed in the pond May 23, 1917. From July 1 until after the spawning season the pond was subjected to frequent observation by the Superintendent, Mr. H. L. Canfield, and others.

The first eggs were discovered July 12 in one of the kegs placed within a foot of the water-surface. The nest was again

examined July 14, and at intervals the parent fish was observed "fanning" the eggs by gentle movements of the tail and fins. This fanning or care of the eggs was continued while the cover of the keg was raised and while an attempt was being made to photograph the nest. Samples of the eggs then taken from the keg with a glass tube and rubber bulb, showed well developed and active embryos.

The eggs were removed from the keg and the mass divided as evenly as possible in halves, one half being retained and the other half returned again to the keg. During the process of dividing the egg-mass, hatching commenced and before arrangements for taking a photograph of the eggs could be made, all had hatched. However, a photograph of the fry was obtained.

An actual count gave a total of 2,945 active and vigorous fry. Including the few dead eggs and a few fry that died, the half of the egg-mass contained 2,972 eggs. Allowing for a slight unequal division of the eggs, the original mass found in the keg contained approximately 5,944 eggs, quite a respectable number when the large size of the eggs is taken into consideration. The young were placed in a trough outdoors to be subjected to the artificial feeding experiments.*

Ten other nests were carefully examined, one of which bore evidence of having been cleaned and two others appeared as though fish had been frequenting them, but nothing definite could be determined. One keg examined July 17, appeared to contain young fish, but further investigation was not made until the following day when 284 were obtained. The top of this keg was 31 inches below the water surface. The small number found in this nest may have been the remnant of a brood the larger portion of which had left the nest earlier. These young fish were also placed in an outdoor trough for artificial feeding experiments.*

We were especially well pleased to get a hatch in the pond again this season and with this start hope and expect to obtain more substantial results next year. While it is yet too early to draw conclusions, the data already secured point to the channel catfish

* When this pond was drained October 21, 1917, young fish to the number of 5,942 were obtained, making a total of 9,171 young catfish for the season.

as a very promising fish for pond culture. The fact that it is easily fed, taking artificial food with avidity, is much in its favor. While it will perhaps not reach a maximum size under ordinary small pond conditions a weight of several pounds should not be considered at all unusual. The growth experiments now in progress will yield very valuable and pertinent information regarding this.